

preserved. Another aspect of the invention includes estimating the required signatures. Another aspect of the invention modifies existing uplink and downlink strategy computation methods by injecting into the received signal sequence a synthetic signal whose signature equals that of the estimated remote user direction, and whose power is proportional to the desired null depth.

IN THE CLAIMS

Please cancel claims 1-55 without prejudice, and enter the following new claims:

56. (New) A method comprising:

computing an antenna processing strategy for a remote user, based at least in part on a received signal data; and

modifying the antenna processing strategy by incorporating signature data relating to one or more interferers with the received signal data to reduce one or both of antenna transmit signal strength in, and sensitivity of the antenna to signals from, one or more interferers.

57. (New) The method of claim 56 wherein incorporating signature data relating to one or more interferers comprises:

combining the received signal data and the signature data; and

computing a modified processing strategy based, at least in part, on the combination.

58. (New) The method of claim 57 wherein combining the received signal data and the signature data further comprises modifying one or more characteristic features of the received signal data with an estimate of the one or more characteristic features in the signature data.

59. (New) The method of claim 58 wherein the estimate includes a selectable parameter.

60. (New) The method of claim 59 wherein the parameter selected is sufficiently large to cause a carrier to interference ratio (CIR) corresponding to the modified characteristic feature to be small.

61. (New) The method of claim 59 wherein the parameter for a co-channel interferer is selected to cause a ratio on downlink of interferer transmit power to remote user transmit power to approximate a ratio of the modified feature estimate of interferer power to remote user power.

62. (New) The method of claim 59 wherein the estimate of the one or more characteristic features of the received signal data comprises an estimate of the covariance of the received signal data.

63. (New) The method of claim 62 wherein the covariance estimate comprises a noise-plus-interference-plus-signal covariance estimate.

64. (New) The method of claim 62 wherein the covariance estimate comprises a noise-plus-interference covariance estimate.

65. (New) The method of claim 62 wherein combining the received signal data and the signature data comprises:

computing a covariance estimate of the received signal data;

computing a covariance estimate of the interferer signature data for each interferer; and

summing the covariance estimate of the received signal data, and the covariance estimate of the interferer signature data scaled by a selectable parameter.

66. (New) The method of claim 62 wherein combining the received signal data and the signature data comprises:

- performing a matrix factorization of the received signal data;
- performing a matrix factorization of the interferer signature data for each interferer;
- scaling the factors of the matrix factorization of the interferer signature data by a selectable parameter; and
- combining the scaled factors and the factors of the matrix factorization of the received signal data.

67. (New) The method of claim 58 wherein combining the received signal data and the signature data further comprises:

- determining supplementary signal data from each interferer signature;
- scaling the supplementary signal data by a selectable parameter; and
- combining the received signal data and the scaled supplementary signal data.

68. (New) The method of claim 67 wherein the parameter selected is sufficiently large to cause a carrier to interference ratio (CIR) corresponding to the modified characteristic feature to be small.

69. (New) The method of claim 67 wherein the parameter for a co-channel interferer is selected to cause a ratio on downlink of interferer transmit power to remote user transmit power to approximate a ratio of the modified feature estimate of interferer power to remote user power.

70. (New) The method of claim 67 wherein the supplementary signal data includes random samples generated from the interferer signature data.

71. (New) The method of claim 67 wherein combining the received signal data and the scaled supplementary signal data comprises:

performing a matrix factorization of the received data and the signature data; and
combining the resulting factors.

72. (New) The method of claim 56 wherein the signature data comprises a known signature for the one or more interferers.

73. (New) The method of claim 56 wherein modifying the antenna processing strategy by incorporating signature data further comprises:

estimating the signature of one or more of the interferers; and
modifying the antenna processing strategy by incorporating the estimate as the interferer signature data.

74. (New) The method of claim 73 wherein estimating the signature comprises determining a high likelihood estimate of an interferer signature, the determination based on the assumption that no remote user signal and no other interferer signals are present.

75. (New) The method of claim 73 wherein estimating the signature comprises determining a high likelihood estimate of an interferer signature, the determination based on the assumption that the remote user signal and all other known interferer signals are present.

76. (New) The method of claim 73 wherein estimating the signature further comprises:

initializing a value for each signature to be estimated; and

iteratively repeating, until a computation to estimate a value for the signature does not alter the value by more than a predetermined amount, for each signature to be estimated:

computing an estimate value for a particular signature while holding the value of the other signatures at their values as initialized; and

using the estimate value as the value for the particular signature in successive computations.

77. (New) The method of claim 56 wherein computing and modifying an antenna processing strategy comprises generating and modifying a set of weights to apply during processing for the remote user.

78. (New) The method of claim 77 wherein the interferers comprise remote users, each having a corresponding weight for communicating with a wireless station, and wherein modifying the set of weights further comprises:

scaling the corresponding weights of each interferer by a selectable parameter; and

adding the scaled weights to the set of weights of the remote user for which the antenna processing strategy is being computed.

79. (New) The method of claim 78 wherein the parameter is selected to force the modified set of weights to be substantially orthogonal to the interferer signature.

80. (New) An apparatus comprising:

a processor to compute an antenna processing strategy for a remote user, the computation based at least in part on received signal data; and

circuitry coupled with the processor, the circuitry to incorporate interferer signature data relating to one or more interferers with the received signal data to modify the processing strategy by reducing one or both of antenna transmit signal strength in, and sensitivity of the antenna to signals from, one or more interferers.

81. (New) The apparatus of claim 80 wherein the circuitry to incorporate signature data relating to each interferer further comprises a combiner coupled with the processor to provide a combination of the received signal data and the signature data, the processor to compute a modified antenna processing strategy based, at least in part, on the combination.

82. (New) The apparatus of claim 81 wherein to provide a combination of the received signal data and the signature data further comprises the circuitry to modify one or more characteristic features of the received signal data with an estimate of the one or more characteristic features in the signature data.

83. (New) The apparatus of claim 82 wherein the estimate includes a selectable parameter.

84. (New) The apparatus of claim 83 wherein the parameter selected is sufficiently large to cause a carrier to interference ratio (CIR) corresponding to the modified characteristic feature to be small.

85. (New) The apparatus of claim 81 wherein the signature data comprises a known signature for the one or more interferers.

86. (New) The apparatus of claim 83 wherein the parameter for a co-channel interferer is selected to cause a ratio on downlink of interferer transmit power to remote user transmit power to approximate a ratio of the modified feature estimate of interferer power to remote user power.

87. (New) The apparatus of claim 83 wherein the one or more characteristic features of the received signal data comprises an estimate of the covariance of the received signal data.

88. (New) The apparatus of claim 87 wherein the covariance estimate comprises a noise-plus-interference-plus-signal covariance estimate.

89. (New) The apparatus of claim 87 wherein the covariance estimate comprises a noise-plus-interference covariance estimate.

90. (New) The apparatus of claim 87 wherein to provide a combination of the received signal data and the signature data comprises the combiner to:

- compute a covariance estimate of the received signal data;
- compute a covariance estimate of the interferer signature data for each interferer; and
- sum the covariance estimate of the received signal data, and the covariance estimate of the interferer signature data scaled by a selectable parameter.

91. (New) The apparatus of claim 87 wherein to provide a combination of the received signal data and the signature data comprises the circuitry to:

- perform a matrix factorization of the received signal data;

perform a matrix factorization of the interferer signature data for each interferer;
scale the factors of the matrix factorization of the interferer signature data by a selectable parameter; and
combine the scaled factors and the factors of the matrix factorization of the received signal data.

92. (New) The apparatus of claim 82 wherein to provide a combination of the received signal data and the signature data further comprises the combiner to combine the received signal data and supplementary signal data determined from each interferer signature, the supplementary data scaled by a selectable parameter.

93. (New) The apparatus of claim 92 wherein the parameter selected is sufficiently large to cause a carrier to interference ratio (CIR) corresponding to the modified characteristic feature to be small.

94. (New) The apparatus of claim 92 wherein the parameter for a co-channel interferer is selected to cause a ratio on downlink of interferer transmit power to remote user transmit power to approximate a ratio of the modified feature estimate of interferer power to remote user power.

95. (New) The apparatus of claim 92 wherein the supplementary signal data includes random samples generated from the interferer signature data.

96. (New) The apparatus of claim 92 wherein to provide a combination of the received signal data and the scaled supplementary signal data comprises the combiner to:
perform a matrix factorization of the received data and the signature data; and

combine the resulting factors.

97. (New) The apparatus of claim 81 wherein to incorporate interferer signature data further comprises:

a signature estimator circuit coupled with the circuitry to estimate the signature of one or more of the interferers; and

the processor to modify the antenna processing strategy by incorporating the estimate as the interferer signature data.

98. (New) The apparatus of claim 97 wherein to estimate the signature comprises the estimator to determine a high likelihood estimate of an interferer signature, the determination based on the assumption that no remote user signal and no other interferer signals are present.

99. (New) The apparatus of claim 97 wherein to estimate the signature comprises the estimator to determine a high likelihood estimate of an interferer signature, the determination based on the assumption that the remote user signal and all other known interferer signals are present.

100. (New) The apparatus of claim 97 wherein to estimate the signature further comprises the estimator to:

initialize a value for each signature to be estimated; and

iteratively repeat, until a computation to estimate a value for the signature does not alter the value by more than a predetermined amount, for each signature to be estimated:

compute an estimate value for a particular signature while holding the value of the other signatures at their values as initialized; and

use the estimate value as the value for the particular signature in successive computations.

101. (New) The apparatus of claim 81 wherein to compute an antenna processing strategy comprises the processor to generate a set of weights to apply during processing for the remote user, and wherein to modify the processing strategy comprises the circuitry to adjust the set of weights.

102. (New) The apparatus of claim 101 wherein the interferers comprise remote users, each having a corresponding weight for communicating with a wireless station, and wherein to adjust the set of weights further comprises the circuitry to:

scale the corresponding weights of each interferer by a selectable parameter; and

add the scaled weights to the set of weights of the remote user for which the antenna processing strategy is to be computed.

103. (New) The apparatus of claim 102 wherein the parameter is selected to force the modified set of weights to be substantially orthogonal to the interferer signature.

104. (New) An article comprising a machine-accessible medium to provide content to cause one or more electronic systems to:

compute an antenna processing strategy for a remote user, based at least in part on received signal data; and

modify the antenna processing strategy by incorporating signature data relating to one or more interferers with the received signal data to reduce one or both of antenna transmit signal strength in, and sensitivity of the antenna to signals from, one or more interferers.

105. (New) The article of claim 104 wherein incorporating signature data relating to each of one or more interferers comprises the one or more electronic systems to:

combine the received signal data and the signature data; and

compute a modified processing strategy based, at least in part, on the combination.

106. (New) The article of claim 105 wherein to combine the received signal data and the signature data further comprises the one or more electronic systems to:

perform a matrix factorization of the received data and supplementary signal data determined for each interferer signature; and

combine the resulting factors of the received data, with the resulting factors of the supplementary signal data scaled by a selectable parameter.

107. (New) The article of claim 105 wherein to combine the received signal data and the signature data further comprises the one or more electronic systems to modify one or more characteristic features of the received signal data with an estimate of the one or more characteristic features in the signature data.

108. (New) The article of claim 107 wherein the estimate includes a selectable parameter.

109. (New) The article of claim 108 wherein to combine the received signal data and the signature data comprises the one or more electronic systems to:

compute a covariance estimate of the received signal data;

compute a covariance estimate of the interferer signature data for each interferer; and

sum the covariance estimate of the received signal data, and the covariance estimate of the interferer signature data scaled by a selectable parameter.

110. (New) The article of claim 108 wherein to combine the received signal data and the signature data comprises the one or more electronic systems to:

perform a matrix factorization of the received signal data;

perform a matrix factorization of the interferer signature data for each interferer;

scale the factors of the matrix factorization of the interferer signature data by a selectable parameter; and

combine the scaled factors and the factors of the matrix factorization of the received signal data.

111. (New) The article of claim 104 wherein to modify the antenna processing strategy by incorporating signature data further comprises the one or more electronic systems to:

estimate the signature of one or more of the interferers; and

modify the antenna processing strategy by incorporating the estimate as the interferer signature data.

112. (New) The article of claim 111 wherein to estimate the signature further comprises the one or more electronic systems to:

initialize a value for each signature to be estimated; and

iteratively repeat, until a computation to estimate a value for the signature does not alter the value by more than a predetermined amount, for each signature to be estimated:

compute an estimate value for a particular signature while holding the value of the other signatures at their values as initialized; and

use the estimate value as the initial value for the particular signature in successive computations.

113. (New) The article of claim 104 wherein to compute and to modify an antenna processing strategy comprises the one or more electronic systems to generate and to adjust a set of weights to apply during processing for the remote user.

114. (New) The article of claim 113 wherein the interferers comprise remote users, each having a corresponding weight for communicating with a wireless station, and wherein to adjust the set of weights further comprises the one or more electronic systems to:

scale the corresponding weights of each interferer by a selectable parameter; and

add the scaled weights to the set of weights of the remote user for which the antenna processing strategy is to be computed.

REMARKS

Applicants respectfully request reconsideration of the present U.S. Patent application. Claims 1-55 have been cancelled. Claims 56-114 have been added. Therefore, claims 56-114 are pending.

Regarding Amendments to Claims 56, 80, and 104

The amendment to claims 56, 80, and 104 removes the word "direction" from the claims. The word "direction" was eliminated to make clear that the invention should not be limited to direction-based smart antenna systems, but that it is equally applicable to fully adaptive and other types of smart antenna systems.

Claim Rejections - 35 U.S.C. § 102

Claims 1, 2, 8-18, 20, 21, 27-32, 38-47, and 52-55 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,973,638 issued to Robbins et al. (*Robbins*).